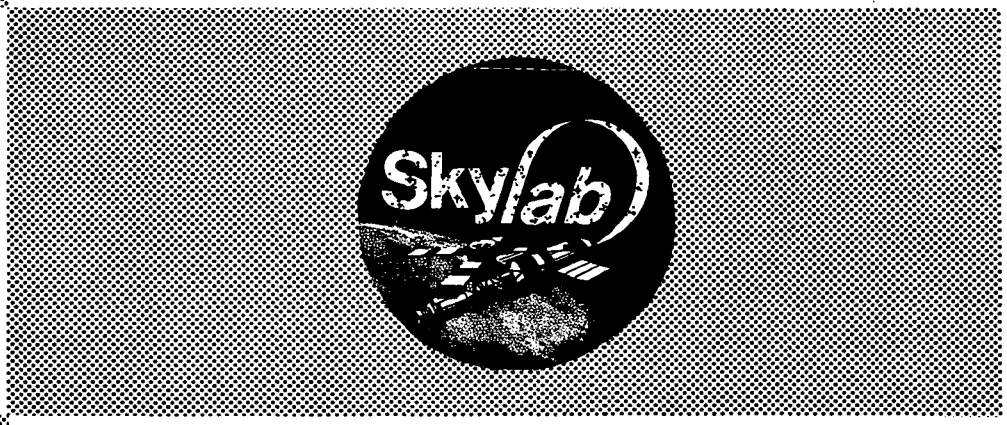
GEORGE C. MARSHALL SPACE FLIGHT CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

1972 NASA-ASEE
SUMMER FACULTY FELLOWSHIP
RESEARCH PROGRAM

NASA CR-61395

FINAL REPORT



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UNIVERSITY OF ALABAMA

SEPTEMBER 1972

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16. ABSTRACT

For the ninth consecutive year, the NASA-ASEE Summer Faculty Fellowship Program was continued in 1972. Six NASA Centers cooperating with nine universities conducted research programs for young engineering and science teaching and research faculty members. In addition to the research programs, there were four systems engineering design programs conducted at four of these Centers.

This year, the research type program at Marshall Space Flight Center was continued for the eighth consecutive year and was directed by Auburn University with assistance from the University of Alabama. This final report presents the results of the program at MSFC.

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MSFC - Form 3292 (May 1969)

THE VALUATION OF SCIENTIFIC AND TECHNICAL EXPERIMENTS

By

Fred E. Williams

ABSTRACT

This study broadly concerns rational selection of scientific and technical experiments for space missions. Particular emphasis is placed on the assessment of "value" or "worth" of an experiment.

It is argued that the assessment of such a "value" necessarily entails judgmental (subjective) inputs; hence "assessment of value" is taken to mean the construction of a numerical index which (1) represents the preferences of an appropriate decision maker (possibly a group) and (2) possesses certain desirable properties. The requirements are satisfied by a Bernoulli Utility Indicator (BUI) representing the decision maker's preferences, hence in operational terms "assessment of value" means specification of such a BUI.

A specification procedure is outlined and discussed for the case of one decision maker. Experiments are viewed as multi-attributed entities and a relevant set of attributes is proposed. Alternative methods of describing levels of the attributes are proposed and discussed. The reasonableness of certain simplifying assumptions such as preferential and utility independence is explored, and it is tentatively concluded that preferential independence almost certainly applies and utility independence appears to be quite appropriate.

The general specification procedure is then extended to include the possibility of more than one decision maker. The feasibility and potential difficulties of this extension are explored, and the suggested procedure is judged to be quite practicable.

MARSHALL-AUBURN-ALABAMA
1972 AERONAUTICS AND SPACE RESEARCH SUMMER FACULTY FELLOWSHIP PROGRAM
PROGRAM PARTICIPANTS

Seated, (L to R): J. M. Olson, G. A. Sawyer, G. R. Karr, J. W. Sheldon, P. D. Smith, A. Sitchin, D. R. Jeng, M. W. Parker

Middle Row, (L to R): J. M. Elliott, J. C. Glaser, D. J. DeSmet, J. H. Kusmiss, F. E. Martin, P. H. DeHoff, J. E. Dudgeon, E. I. Griggs, J. D. Moore

Back Row, (L to R): J. F. O'Brien, Jr.,(Program Director), K. H. Hawks, R. A. Morrison, F. E. Williams, J. W. Rogers, J. L. Dodd

Not Pictured: W. L. Hendricks, R. B. Honea, R. S. Rudland, D. C. Raney (Associate Director)

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SECTION I. INTRODUCTION

For the ninth consecutive year, the ASEE-NASA Summer Faculty Fellowship Program was continued in 1972. Six National Aeronautics and Space Administration Centers cooperating with nine universities conducted research programs for young engineering and science teaching and research faculty members. The participants represented colleges and universities from almost every state. In addition to the research programs, there were four systems engineering design programs conducted at four of these Centers. These programs are sponsored by the American Society for Engineering Education (ASEE) and supported by the Office of University Affairs, Headquarters, NASA, Washington, D.C.

The objectives of this national program (started in 1964) are:

1. To further the professional knowledge of qualified engineering and science faculty members.

2. To stimulate an exchange of ideas between participants and NASA.

3. To enrich and refresh the activities of the participant's institution.

This year, the research type program at Marshall Space Flight Center was continued for the eighth consecutive year. The 1972 program at MSFC was directed by Auburn University with assistance from the University of Alabama. The official period of the program was from June 5, 1972, through August 11, 1972. A total of twenty-five college and university professors participated in the program.

SECTION II. RECRUITING, SELECTION, AND ASSIGNMENT OF FELLOWS

A. Recruiting

A central advertising program was designed and implemented in 1968 and was conducted by the Headquarters Office, ASEE, Washington. This program was continued and improved through the subsequent years including 1972. The advertising program consists of placing descriptive ads in the Aeronautics and Astronautics magazine and the Journal for Engineering Education. Also, brochures and flyers (See Figure 1) are sent to a majority of the deans and department chairmen in the engineering and scientific community. Responses to inquiries were made by sending a brochure containing complete details of all ten programs (research and design). In addition, each program Co-Director sends the descriptive material to a number of acquaintances in the educational community. As a result of this comprehensive coverage, the number of applications continued to be overwhelming.

B. Selection

Following the practice of past years, the selection committee consisted of the Director and the Associate Director and the NASA Representative, Mr. O'Brien, Dr. Raney, and Mr. Kent.

Since it is intended that a Fellow, once selected, may participate for 2 years (assuming the program continues from year to year), first priority is given to selecting second year Fellows from the first year Fellows of the immediately preceding year. Each Fellow was contacted and asked to commit himself so that the number of slots filled with second year Fellows could be determined. Fourteen of the fifteen authorized second year slots were claimed by this

Summer Faculty Fellowships

For U.S. citizens who are faculty or research staff members, preferably with two years of teaching experience.

NASA National Aeronautics & Space Administration **&** **ASEE** American Society for Engineering Education

ENGINEERING SYSTEMS DESIGN

OBJECTIVES: (1) To increase competence and to develop concepts which will enable participants to organize multidisciplinary engineering systems design programs and courses at their home institutions. (2) To establish and further communication and collaboration between engineering and other disciplines.

DESIGN FELLOWSHIPS: Awarded to young engineering and science faculty members in programs of summer study to be undertaken by several universities in cooperation with NASA research centers. Fellows will come to universities adjacent to NASA centers to participate as members of multidisciplinary design teams. Each group will select and design a complex engineering system, such as an unmanned planetary reconnaissance vehicle, an environmental monitoring and control system, or an information management system. The Fellows will be associated directly with the NASA program and will be confronted with the most modern systems design problems. The engineering systems concept, that of approaching the design problem in its entirety, will be utilized by the faculty design teams.

FELLOWSHIPS: Stipends are intended to meet the salary of the participant but will not exceed $275 per week. Travel allowance will be paid. Approximately 80 Fellowships will be awarded. Several faculty members from a single university are encouraged to participate as a part of a design team.

DURATION: 11 weeks.

PROGRAM DESCRIPTIONS

Marshall Space Flight Center — **Auburn University**
June 5-August 18, 1972

A complete systems design study of a user oriented Earth Resources Information Management System.

Ames Research Center — **Stanford University**
June 12-August 25, 1972

The design of a system for the non-agricultural production of food.

Langley Research Center — **Old Dominion University**
June 12-August 25, 1972

Engineering systems design approach to achieving benefits from human factors engineering in current transportation systems.

Manned Spacecraft Center — **University of Houston, Rice University**
June 5-August 18, 1972

A systems study and design of a self-sufficient ecosystem for future application to future lunar and planetary colonization as well as long duration space missions.

AERONAUTICS AND SPACE RESEARCH

OBJECTIVES: (1) To further the professional knowledge of qualified engineering and science faculty members. (2) To simulate an exchange of ideas between participants and NASA. (3) To enrich and refresh the research and teaching activities of participants' institutions.

RESEARCH FELLOWSHIPS: Awarded to young engineering and science faculty members for summer research in a NASA-university cooperative program. Fellows will conduct research projects of mutual interest to the Fellow and to the NASA center. Each Fellow will work with a center colleague and will be associated directly with the aeronautics and space program and the concomitant basic research problems. Special courses, seminars, workshops, lectures and the like are included in each cooperative program. These Fellowships may be renewed for a second summer subject to the availability of funds.

FELLOWSHIPS: Stipends are intended to meet the salary of the participant but will not exceed $250 per week for first-year Fellows or $275 per week for second-year Fellows. Travel allowance will be paid. Approximately 60 first-year Fellowships will be awarded.

DURATION: 10 weeks.

PROGRAM DESCRIPTIONS

Goddard Space Flight Center — **The Catholic University of America, University of Maryland**
June 12-August 18, 1972

The research programs include communication and telemetry, computers, quantum electronics, antennas, automatic control and space science.

Marshall Space Flight Center — **Auburn University, University of Alabama**
June 5-August 11, 1972

Research in aero-astrodynamics, astrionics, computation and space sciences and other basic and applied disciplines.

Manned Spacecraft Center — **University of Houston, Texas A&M University**
June 5-August 11, 1972

Science and applications research in planetary and earth sciences, space medicine and environmental physiology, life support systems, communications, guidance and control, spacecraft propulsion and power generation, structures and mechanics, aerodynamics, spacecraft design and flight operations.

Langley Research Center — **Old Dominion University**
June 12-August 18, 1972

Research opportunities encompass aerodynamics, structures, materials, operating problems, fluid mechanics, mechanics of flight, energy conversion, space environmental physics, and many others.

Lewis Research Center — **Case Western Reserve University**
June 12-August 18, 1972

All aspects of research and advanced technology related to propulsion from air-breathing engines and chemical rockets to nuclear and electromagnetic rockets and to power generation from Brayton and Rankine cycle turbogenerators and direct energy conversion devices to solar cells, fuel cells, and thermionic and magnetohydrodynamic generators.

Ames Research Center — **Stanford University**
June 19-August 25, 1972

Topics for research from aeronautics, atmospheric entry technology, avionics, computer sciences, earth resources, environmental biology, exobiology, biotechnology, instrumentation, spaceflight and systems engineering.

Only U.S. Citizens are eligible

For application forms and information please contact:
Mr. F. X. Bradley, Jr., American Society for Engineering Education
Suite 400, One Dupont Circle
Washington, D. C. 20036 Phone: 202-293-7080

APPLICATION DEADLINE: March 1
ANNOUNCEMENT OF AWARDS: March 15

1972

FIGURE NO. 1. PROGRAM ADVERTISEMENT FLYER

group. Consequently, the next priority went to first year Fellows in programs of earlier years who had not returned for their second year. The fifteenth slot was filled by a Fellow who was a first year Fellow in 1970. When the Second year commitments were made, the available number of fellowships for new, first year Fellows, was determined.

Each application for a first year slot, including the letters of recommendation from the applicant's references, was carefully reviewed and the applicants were categorized into their respective areas of engineering and/or scientific interests. Consideration was given to possible work assignment areas for the applicants, the applicant's level of research experience, the university represented, the geographical spread of the applications, the applicant's age and teaching experience, and potential benefits to both the individual and school.

The MSFC/Auburn/Alabama program received 41 applications listing MSFC as their first choice. Determination of the recipients of awards was most difficult and time consuming. Consultation with others at MSFC such as laboratory directors and researchers and further inquiry into each applicant's background were done until offers were made and acceptances were received for 10 first year Fellows. There were 15 second year participants. (See Appendix for complete statistics.)

Applications of those who were not extended an offer were then released to their second choice programs.

C. Assignment of Fellows

Continuing a procedure initiated in the early years of the program, the NASA representative obtained abstracts of possible

research problems from laboratories and other groups throughout MSFC who had indicated interest in the Summer Faculty Fellowship Program. A book of more than 200 abstracts, containing descriptions of research topics and names, addresses, and phone numbers of MSFC contacts, was prepared.

Each first year Fellow was sent a copy of the book containing suggested research assignment abstracts. A number of the Fellows had previous contact with MSFC and were already familiar with several work possibilities. However, all participants used the information to determine an area of interest, contacted the counterparts involved, and were ready to begin work on the first day of the program. Several participants visited the Center at their own expense prior to the official starting day. This proved beneficial to those who were able to do so.

In general, the program was "off and running" on the first day with a minimum of distractions and need for orientation.

SECTION III. PROGRAM DESCRIPTION AND ADMINISTRATION

The 1972 MSFC/Auburn/Alabama program was developed by a committee representing MSFC, Alabama, and Auburn. This was essentially the same committee involved in earlier programs. They are: J. Fred O'Brien, Jr., John L. Cain, Auburn University; Donald C. Raney, University of Alabama; and Marion I. Kent, Robert R. Head, William Murphree, Ray V. Hembree, William D. Clarke, and James A. Downey, MSFC. The program Director was J. Fred O'Brien, Jr., Auburn University, the Associate Director was Donald C. Raney, University of Alabama, and the NASA representative was Marion I. Kent.

The program was essentially the same in format as has been used in past years. Each year, however, innovations and/or improvements result from the suggestions and evaluations of participants and supervisors and from the Co-Directors' observations. This year, continued emphasis was placed in three areas. These were:

1. Early contact between participants and MSFC employees (either by phone, visit, or mail) was again strongly emphasized. The MSFC Counterparts supplied an abundance of research area definitions. Each accepting participant was strongly urged to select his work, contact the MSFC affiliate and establish a relationship before arriving. Also, the MSFC Counterparts were encouraged to contact those Fellows who showed interest in his area of work. This year, the preliminary contact was excellent and very helpful.

2. Although it has been satisfactorily completed in previous years, a further effort was made to reduce the task of badging, providing car decals, and accomplishing other first day administrative details. Because of the total cooperation of the MSFC Security Office,

this was accomplished within an hour at the check-in station, and the Fellows were immediately able to move freely within the Center.

3. A suggested uniform format for the participant's final report was given to the participant with "ground rules" for composition. This had a positive effect, particularly in reproduction of the final volume.

A. Research Assignments

As has been the successful and desired division of time in prior years, the 1972 Fellow spent approximately 85 percent of his time in his research assignment and 15 percent in seminars and on tours.

Each Fellow observed the specific working hours and discipline of the respective laboratory in which his chosen research effort was located. He interfaced with his Research Advisor on the goals, suggested approach, equipment, and other details related to the assignment. In many cases, the Fellow was asked to do other things such as participate in staff meetings, travel to other installations on activity relating to his work, comment on other related activity within his competency, and, in general, respond as any permanent employee would do.

Each Fellow was required to submit a brief report of his research activity to the Directors. This was in addition to any other requests made of him by his laboratory. In many cases, the Fellow actually authored an Internal Note, or some other instrument of original work. Copies of the abstract of each Fellow's report appear as Appendix II in this report. A separate volume contains the assembly of all reports in full.

B. Tours and Seminars

Continuing in a similar manner as to previous years, the seminar program was designed to expose the Fellows to a broad presentation on subjects related to aerospace technology. Each speaker was furnished a list of the participants that also contained information of their interests and background.

An outstanding group of speakers was obtained from industry, universities, and MSFC. The wide range of subject matter was intentional so that the interest of most of the Fellows would be touched. However, as was the case in prior years, it was intended to acquaint the Fellows with the space program in general, the role of MSFC and NASA in particular, and with the expanding technology with respect to space flight.

C. Seminar and Tour Schedule

Seminars:

Monday, June 5, 1972

Orientation Meeting
Welcome: Dr. Eberhard F.M. Rees
Director, MSFC
Lecture: "NASA & MSFC Mission & Organization"
Mr. Erich McInnis,
Executive Staff, MSFC

Thursday, June 8, 1972

"Materials Overview"
Mr. Robert J. Schwinghamer
Materials Div., Astronautics Lab, MSFC

Thursday, June 15, 1972

"Information Management"
Dr. R. I. Vachon, Alumni Professor
Auburn University and Director
Auburn Summer Faculty Design Program, MSFC

Tuesday, June 20, 1972

"Show and Tell"; Five Minute Presentations
by the 1972 Faculty Participants

Thursday, June 22, 1972

"Environmental Applications of Space Age
Technology"
Dr. George F. McDonough
Director, Environmental Applications Office, MSFC

Tuesday, June 27, 1972

"SKYLAB Experiments Overview"
Mr. Henry Floyd
Deputy Manager, SKYLAB Experiment Projects, MSFC

Thursday, June 29, 1972

"Life Support Systems in Space"
Mr. George Hopson, Astronautics Lab, MSFC

Thursday, July 6, 1972

"Structural Control Interaction Problems"
Mr. Robert Tyan, Aero-Astrodynamics Lab, MSFC

Wednesday, July 19, 1972

"Space Exploration During the Next Twenty Years"
Dr. Ernst Stuhlinger
Associate Director for Science, MSFC

Thursday, July 27, 1972

"NASA University Programs"
Dr. Frank Hansing
Director, University Affairs Office,
Headquarters, NASA, Washington, D.C.

Wednesday, August 9, 1972

"What Did I Do In the Summer of '72"
Mr. Walter Weisman
Communications Consultant (NASA Retired),
Huntsville, Ala.

Thursday, August 10, 1972

"Treasure from the Sea"
Mr. John P. Jones
President, Real 8 Company, Melbourne, Fla.

Friday, August 11, 1972

Lecture: "NASA/MSFC University Affairs Office and Programs"
Mr. Marion I. Kent
Assistant Director for University Affairs, MSFC
Final Briefing: Mr. J. Fred O'Brien, Jr., Program Director
Dr. Donald C. Raney, Program Assoc. Director

Tours:

Tuesday, June 6, 1972

Marshall Space Flight Center

Tuesday, June 13, 1972

Wives Tour, Marshall Space Flight Center
Tour, Redstone Scientific Information Center (Library)
Tour of MSFC Computer Center

Monday, Tuesday, July 17, 18, 1972

Manned Spacecraft Center, Houston, Texas

Sunday, Monday, July 30, 31, 1972

Kennedy Spacecraft Center

In an attempt to determine the effectiveness of the seminars and tours, a questionnaire was completed by the participants. The questionnaire contained the following rating questions:

Seminars: Rate (10 is High)

Subject Interesting? 10 9 8 7 6 5 4 3 2 1 0

Delivery Technique? 10 9 8 7 6 5 4 3 2 1 0

Speaker Well Informed on Subject? 10 9 8 7 6 5 4 3 2 1 0

Tours:

Thorough? 10 9 8 7 6 5 4 3 2 1 0

Briefers' Presentations? 10 9 8 7 6 5 4 3 2 1 0

Length of Time Adequate? 10 9 8 7 6 5 4 3 2 1 0

The following numerical ratings were received:
(Not All Were Rated)

Seminars		Tours	
McInnis	7.3	Marshall	7.5
	7.9		7.5
	8.4		7.6
Schwinghamer	7.5	RSIC (Library)	8.6
	8.2		8.6
	8.1		8.9
Vachon	8.2	Computer Lab	7.1
	7.9		7.6
	8.8		7.3
McDonough	8.8	MSC (Houston)	6.6
	8.9		7.9
	8.9		7.1
Floyd	7.4	Kennedy	7.5
	7.6		8.2
	8.2		7.9
Hopson	8.5		
	8.5		
	9.0		
Ryan	8.0		
	8.1		
	8.9		
Stuhlinger	9.7		
	9.8		
	9.8		
Weisman	9.7		
	9.6		
	9.7		

It is concluded from the above information that the seminars and tours were very well received and should be continued.

SECTION IV. PROGRAM EVALUATION

A. General Comments.

The Directors of the program were in constant contact with the various laboratory personnell (especially the NASA research counterparts) during the summer period. In all conversations and discussions, it was very clear that the program is being well accepted and there is much enthusiasm among the NASA associates that the goals of the program be achieved. Total cooperation from all areas of contact within the Center was encountered. As in past years, a good indicator of the success of the program is the active competition among the laboratories and offices on the Center.

To document the attitudes of both the participants and the MSFC Research Advisors', questionnaires were completed by each of these groups and returned to the Director. Figures 2 and 3 are these questionnaires and a summary of the answers is included herein.

B. Summary of Participants' Replies on Questionnaire.

Answers to questions inviting a yes/no answer have been indicated, but in most cases, the narrative answers and/or comments have been summarized due to the wide ranging responses by the participants and advisors.

5. The following replies were received regarding the stipend.

Meager	18
Adequate	5
Generous	2

6. The following replies were received regarding housing.

yes	11
no	14

NASA-ASEE SUMMAR FACULTY FELLOWSHIP PROGRAM

EVALUATION QUESTIONNAIRE FOR USE BY ASEE SPACE ENGINEERING COMMITTEE

(To Be Completed by Participant)

1. NAME _____
2. INSTITUTION _____
3. NAME OF NASA COUNTERPART _____
4. LABORATORY AND ADDRESS OF COUNTERPART _____
5. EVALUATION OF STIPEND (MEAGER, ADEQUATE, GENEROUS) _____
6. DID YOU HAVE DIFFICULTY FINDING HOUSING? _____
7. WAS INFORMATION SUPPLIED PRIOR TO START OF PROGRAM SATISFACTORY? _____
8. SUGGESTIONS OF OTHER INFORMATION WHICH MIGHT HAVE BEEN HELPFUL _____
9. BRIEF DESCRIPTION OF RESEARCH TOPIC _____
10. DID YOU HAVE A REASONABLE CHOICE OF RESEARCH TOPIC AFTER ARRIVING AT MSFC? _____
11. WAS THE TOPIC CHALLENGING? _____
12. WAS THE TOPIC IN A FIELD SATISFACTORILY NEAR YOUR BASIC RESEARCH INTERESTS? _____
13. WERE YOUR RELATIONS WITH YOUR COUNTERPART SATISFACTORY FROM A TECHNICAL POINT OF VIEW? _____
14. SUGGESTIONS FOR IMPROVEMENT OF RELATIONSHIP _____
15. CONSIDERING THE CIRCUMSTANCES OF A SUMMER PROGRAM, WERE YOU AFFORDED ADEQUATE FACILITIES AND SUPPORT? _____
16. IF ANSWER TO 15 IS NO, PLEASE COMMENT. _____
17. DO YOU THINK THAT YOU HAVE BEEN STIMULATED TO CONTINUE OR EMBARK ON NEW RESEARCH AS A RESULT OF YOUR EXPERIENCE AT MSFC? _____
18. DO YOU ANTICIPATE THAT YOUR ACTIVITIES MAY RESULT IN A NASA CONTRACT WITH YOU? _____
19. DO YOU THINK THAT THE RATIO OF TIME SPENT ON RESEARCH TO TIME SPENT ON OTHER ACTIVITIES SUCH AS SEMINARS AND TOURS WAS APPROPRIATE? _____
20. IF YOUR ANSWER TO 19 IS NO, PLEASE COMMENT. _____
21. CONSIDERING THE WIDELY VARYING BACKGROUND OF THE FELLOWS, DO YOU THINK THAT THE SEMINARS WERE REASONABLY INTERESTING AND VARIED? _____
22. PLEASE SUGGEST SPECIFIC INDIVIDUALS FOR FUTURE SEMINAR PROGRAMS (INCLUDE TOPIC AND ADDRESS):
    A. OUTSIDE SPEAKERS _____
    B. MSFC SPEAKERS _____
23. PLEASE COMMENT ON WHAT ARE, IN YOUR OPINION, THE WEAK POINTS OF THE PROGRAM. _____
24. PLEASE COMMENT ON WHAT ARE, IN YOUR OPINION, THE STRONG POINTS OF THE PROGRAM. _____
25. OTHER REMARKS _____

FIGURE NO. 2. PARTICIPANT'S EVALUATION QUESTIONNAIRE

NASA-ASEE SUMMER FACULTY FELLOWSHIP PROGRAM

EVALUATION QUESTIONNAIRE FOR USE BY ASEE SPACE ENGINEERING COMMITTEE

(To Be Completed by NASA Counterpart)

1. NAME _____
2. LABORATORY/DIVISION/BRANCH _____
3. NAME OF FACULTY FELLOW WORKING WITH YOU _____
4. WAS FELLOW ADEQUATELY PREPARED FOR HIS PROJECT? _____
5. COMMENTS ON PREPAREDNESS _____
6. DID FELLOW CONTRIBUTE TO RESEARCH PROGRAM? _____
7. COMMENTS ON CONTRIBUTIONS _____
8. COMMENTS ON FELLOW'S COOPERATIVENESS, DILIGENCE, INTEREST, ETC. _____
9. IN YOUR OPINION, HAS PARTICIPATION ON THE NASA-ASEE PROGRAM CONTRIBUTED TO AN INCREASE IN THE FELLOWS' POTENTIAL TO PERFORM RESEARCH? _____
10. WERE YOUR RELATIONS WITH THE FELLOW SATISFACTORY FROM A TECHNICAL POINT OF VIEW? ___
11. SUGGESTIONS FOR IMPROVEMENT OR RELATIONSHIP _____
12. CONSIDERING THE OVERALL OBJECTIVES OF THE PROGRAM, DO YOU THINK THAT THE DIVISION OF TIME BETWEEN RESEARCH AND OTHER ACTIVITIES FOR THE FELLOW WAS PROPER? _____
13. COMMENTS ON DIVISION OF TIME _____
14. A. DO YOU THINK THAT ASSOCIATION WITH A FACULTY FELLOW DURING THE SUMMER IS STIMULATING AND/OR BENEFICIAL TO MEMBERS OF YOUR BRANCH OR DIVISION? _____
    B. DO YOU FEEL THAT THE FACULTY FELLOW IS STIMULATED BY ASSOCIATION WITH MEMBERS OF YOUR BRANCH OR DIVISION? _____
15. PLEASE SUGGEST NAMES OF MSFC PERSONNEL (AS WELL AS TOPICS) WHOM YOU BELIEVE SHOULD PRESENT SEMINARS ON THE SUMMER PROGRAM. _____

FIGURE NO. 3. RESEARCH ADVISOR'S (NASA COUNTERPART) EVALUATION QUESTIONNAIRE

7. Replies concerning information sent prior to beginning of program.

yes	23
no	2

8. There were three suggestions regarding obtaining housing, two suggestions requesting more specific information on research problems, and one suggestion requesting earlier notification of acceptance.

9. See abstracts.

10. Was reasonable choice of research topic given?

yes	25
no	0

11. Was research topic challenging?

yes	25
no	0

12. Was research near basic interests?

yes	24
no	0
maybe	1

13. Was relations with counterpart satisfactory?

yes	25
no	0

14. The only comments concerned more communication before arrival and more time for technical discussions.

15. Adequate facilities?

yes	25
no	0

16. Comments on facilities:

a. like to see better computer turnaround time
b. better secretarial services could be given

17. Has experience been stimulating to continue.

yes	25
no	0

18. Contract?

yes	8
no	5
maybe	6
don't know	6

19. Was ratio of time to other activities appropriate?
&
20.

yes	23
no	1
no answer	1

21. Seminars interesting

yes	24
no	1

22. List of names submitted not recorded here. Names may by used by next year's Director.

23. Not all participants answered this question but all answers received would fall into the following:

a. Program too short
b. Stipend low
c. Some Seminars overlapped
d. Need help to facilitate continuation of work at home.

24. All comments received have been summarized as follows:

a. Excellent opportunity to learn space program
b. Excellent planning, organization and coordination
c. Good cooperation of MSFC people
d. Close contact with up to date problems
e. Broadening research ideas by working in different environment
f. Seminars and tours excellent
g. Wide choice of research opportunity

25. All comments received have been summarized as follows:

C. Summary of Research Advisor's Replies on Questionnaire

As in the case of the replies to the participant's questionnaire, the remarks by the counterpart have been summarized as follows:

4. Was Fellow adequately prepared?

yes	25
no	0

5. The comments concerning participant preparedness indicated that the Fellows had excellent backgrounds for their work, and that through early contact with the Center, further prepared for the summer's work. In some cases with second year Fellows, work had progressed since last year and he had his second year's work already outlined.

6. Fellows contribute?

yes	25
no	0

7. There were no negative replies to this question. Such comments as "promising new diagnostic technique was developed based on theoretical work by Fellow" and "extended capability of Aeroheating Environments" and "work results can be used to re-evaluate density valves derived from satellite orbital decay analyses" indicate that much valuable contribution was made.

8. Most replies were "excellent" or "very good", or "outstanding". There were no negative remarks.

9. Only 13 answers were received and ten indicated a yes. The other three indicated there was already an excellent research potential and was probably not improved.

10. Relations satisfactory?

yes	24
most of time	1

11. Only four comments received and they were concerned with items such as language barrier, needed more time, and a better understanding of NASA's mission.

12. Division of time appropriate?

yes	21
no	4

13. Most comments on division of time were suggesting that the Fellow be allowed more time for research activities.

14. Association of Fellow stimulating to group?

A.	yes	24
	no	0
	sometimes	1
B.	yes	22
	maybe	2
	don't know	1

15. Names not tabulated here. Information will be used by next year's Director.

SECTION V. CONCLUSIONS AND RECOMMENDATIONS

1. After the eighth consecutive summer, the Faculty Fellowship Program continues to be a very highly accepted program by both participants and NASA/MSFC. It is concluded that all major operational and administrative problems have been solved and the program will continue to be one of the best programs of its type being conducted within the NASA-university interface.

2. The large number of applicants responding to program advertisement continues to reflect a wide interest in the program. Consequently, the quality of the applicants continues to rise. It is concluded that this program will continue to attract the top engineering and science educators and that the activity and quality of performance of future Fellows will increase.

3. It is concluded that the goals of reaching and involving young, promising teaching and research faculty members to further their professional knowledge, exchange ideas with NASA counterparts, and refresh their home institution activities are definitely being realized.

4. It is concluded that the program should definitely be continued. It is recommended that the same number of participants be included. The program format should remain the same, although it would not be objectionable to lengthen it to 12 weeks on an optional basis.

5. Because of the increasing disparity between the participant's average weekly salary and the present level of stipend, it is highly recommended the stipend be raised to $275.00 and $300.00 per week for first and second year participants respectfully.

APPENDIX I

A. List of 1972 Participants

B. Program Statistics

A. List of 1972 Participants

1. Second Year Fellows

Dr. Paul H. DeHoff
PhD, Assoc. Professor, 38, Bucknell University
LAB: Astronautics
TOPIC: Time-Dependent Structural Analysis of Metal-Epoxy Composites
SPONSOR: John E. Key

Dr. Donald J. DeSmet
PhD, Assistant Professor, 32, University of Alabama-Tuscaloosa
LAB: Space Sciences
TOPIC: A Study of the Growth of Single Crystals
SPONSOR: Mirt C. Davidson

Dr. James E. Dudgeon
PhD, Assistant Professor, 32, University of Alabama-Tuscaloosa
LAB: Astrionics
TOPIC: Shaped Beam Ku-Band Antenna Design
SPONSOR: Grady H. Saunders

Dr. J. Mark Elliott
PhD, Assistant Professor, 29, University of South Alabama
LAB: Environmental Applications
TOPIC: A Preliminary Study of a Buoy System for Acquisition, Transmission, and Management of Hydrological Data obtained from In-Situ Measurements
SPONSOR: Charles T. N. Paludan

Dr. Edwin I. Griggs
PhD, Assistant Professor, 34, Tennessee Tech. University
LAB: Astronautics
TOPIC: Investigation of Some Characteristics Related to PCM Thermal Capacitors
SPONSOR: W.R. Humphries

Dr. Keith H. Hawks
PhD, Assistant Professor, 31, Purdue University
LAB: Program Development
TOPIC: Thermal Control of the Scientific Instrument Package
SPONSOR: Carl G. Fritz

Dr. Frank E. Martin
PhD, Professor, 59, Central Missouri State University
LAB: Space Sciences
TOPIC: Determination of Optical Constants of In Bi from Reflectance Measurements
SPONSOR: Roger L. Kroes
Roger C. Linton

Dr. Richard A. Morrison
PhD, Assistant Professor, 32, Talladega College
LAB: Astronautics
TOPIC: Optical Production and Detection of Ultrasonic Waves for Nondestructive Testing
SPONSOR: Ray Gause

Dr. Judy M. Olson
PhD, Assistant Professor, 28, University of Georgia
LAB: Aero-Astrodynamics
TOPIC: An Analysis of Texture on Lunar Ground Photos
SPONSOR: O. H. Vaughan, Jr.

Dr. Murl W. Parker
PhD, Associate Professor, 33, Mississippi State University
LAB: Astronautics
TOPIC: Simulation, Manual and Computerized
SPONSOR: Ronald A. Schlagheck

Dr. Robert S. Rudland
PhD, Instructor, 33, California State Polytechnic Institute
LAB: Aero-Astrodynamics
TOPIC: Avoidance of Trailing Vortex Hazard by Airport Warning System
SPONSOR: Harold Jeffreys

Dr. Gary A. Sawyer
PhD, Assistant Professor, 33, South Dakota State University
LAB: Aero-Astrodynamics
TOPIC: Orbit Perturbations Due to Solar Radiation Pressure
SPONSOR: Larry D. Mullins

Dr. John W. Sheldon
PhD, Associate Professor, 39, Florida International University
LAB: Space Sciences
TOPIC: A Multi-Ring Ionospheric Plasma Probe
SPONSOR: Nobie H. Stone

Dr. Amnon Sitchin
PhD, Associate Professor, 42, University of Alabama-Tuscaloosa
LAB: Aero-Astrodynamics
TOPIC: Cable Connected Spinning Spacecraft; The Canonical Equations; Urban Mass Transportation
SPONSOR: Burt Lewis

2. First Year Fellows

Dr. Jimmy L. Dodd
PhD, Associate Professor, 36, Mississippi State University
LAB: Aero-Astrodynamics
TOPIC: Smoke Plume Analysis Using Fan-Beam and Single-Beam Radiometers
SPONSOR: G. H. R. Reisig

Dr. Jerome C. Glaser
PhD, Assistant Professor, 34, Iowa State University
LAB: Astronautics
TOPIC: A Limited Survey of General Purpose Finite Element Computer Programs
SPONSOR: John E. Key

Dr. William L. Hendricks
PhD, Assistant Professor, 28, California State Polytechnic College
LAB: Aero-Astrodynamics
TOPIC: Nonequilibrium and Equilibrium Radiation to the Space Tug from the Shock Layer
SPONSOR: William Lake

Professor Robert B. Honea
M.S., Assistant Professor, 31, East Tennessee State University
LAB: Environmental Applications
TOPIC: The Prospects of Utilizing Remotely Sensed Data in the Preparation of Environmental Sociological Models
SPONSOR: James C. Derington

Dr. Duen-Ren Jeng
PhD, Associate Professor, 40, University of Toledo
LAB: Astronautics
TOPIC: Study of Ice Particle Formation and Lifetime in Space Environment
SPONSOR: Charles A. Cothran

Dr. Gerald R. Karr
PhD, Assistant Professor, 30, University of Illinois
LAB: Aero-Astrodynamics
TOPIC: Satellite Aerodynamics and Atmospheric Density Determination from Satellite Dynamic Response
SPONSOR: Robert E. Smith

Dr. John H. Kusmiss
PhD, Associate Professor, 34, Western Michigan University
LAB: Space Sciences
TOPIC: Large Silver Halide Single Crystals as Track Detectors for Heavy Charged Particles
SPONSOR: Thomas A. Parnell

Dr. Jerry D. Moore
PhD, Assistant Professor, 34, La. Tech. University
LAB: Astrionics
TOPIC: Data Transmission Signal Design and Analysis
SPONSOR: Frank H. Emens

Dr. Jerry W. Rogers
PhD, Associate Professor, 41, Mississippi State University
LAB: Astrionics
TOPIC: Coherent Optical Processing of Phased Array Radar Data
SPONSOR: Joe Kerr

Dr. Paul D. Smith
PhD, Assistant Professor, 37, Auburn University
LAB: Program Development
TOPIC: Automatic Control of Personal Rapid Transit Vehicles
SPONSOR: Charles P. Elms

Dr. Fred Williams
PhD, Associate Professor, 33, Georgia Institute of Technology
LAB: Central Systems Engineering
TOPIC: The Valuation of Scientific and Technical Experiments
SPONSOR: Stanley A. Johns

B. Program Statistics

1.	Applications (MSFC First Choice)	41
2.	Number of First Year Fellowship Offers	16
3.	Number of First Year Fellows	10
4.	Number of Second Year Offers 1971 Fellows - 14 Other Years - 1	
5.	Number of Second Year Fellows	15
6.	Total Fellows in 1972	25
7.	Average Age	34.8
8.	Average Weekly Salary	$357.00
9.	PhD	24
10.	M.S.	1
11.	Professors	1
12.	Associate Professors	9
13.	Assistant Professors	14
14.	Instructors	1
15.	Universities and Colleges Represented	20
16.	States Represented	15
17.	Engineering and Scientific Disciplines Represented	10

1. Mechanical Engineering (6)
2. Electrical Engineering (5)
3. Aeronautical Engineering (3)
4. Civil Engineering (1)
5. Industrial Engineering (1)
6. Nuclear Engineering (1)
7. Engineering Mechanics (1)
8. Industrial Management (1)
9. Geography (2)
10. Physics (4)

18. MSFC Laboratory Distribution

Aero-Astrodynamics Laboratory	7
Astronautics Laboratory	6
Space Sciences Laboratory	4
Astrionics Laboratory	3
Environmental Applications Office	2
Program Development Directorate	2
Central Systems Engineering Office	1

APPENDIX II:

ABSTRACTS OF FELLOWS' RESEARCH ACTIVITY

TIME-DEPENDENT STRUCTURAL ANALYSIS OF METAL-EPOXY COMPOSITES

By

Paul H. DeHoff

ABSTRACT

In an effort to reduce structural weight while maintaining structural integrity on the Space Shuttle and other proposed space vehicles, various composite materials are being evaluated to determine their applicability and reliability in load carrying situations. While most of the composites being considered for structural components are of the metal-metal type, there are some applications for which metal-epoxy composites are proposed. Since the metal-epoxy composites demonstrate time-dependent behavior, it will be necessary to update the existing NASA structural analysis programs to include viscoelastic effects.

In this study an approximate method is presented to analyze plane stress orthotropic linear viscoelastic problems under isothermal conditions. A computer program which is based on the method was used to solve a simple uniaxial creep problem for a Maxwell type material. This solution is presented and compared with the analytical solution.

A STUDY OF THE GROWTH OF SINGLE CRYSTALS

By

Donald J. DeSmet

ABSTRACT

Research on the growth of single crystals of the III-V compound indium antimonide has been pursued in order to gain a firsthand knowledge of some of the factors which govern the growth of single crystals of this compound. These studies were conducted using a standard Czochralski crystal pulling furnace. This type of furnace allows crystals to be formed without being constrained to a crucible. Several factors were found to have a large detrimental effect on the growth of single crystals of indium antimonide, the most important of which seems to be the degree to which the enviornment surrounding the crystal during growth can be controlled. Ways in which to overcome these effects have been determined and are oulined.

SMOKE PLUME ANALYSIS USING FAN-BEAM AND SINGLE-BEAM RADIOMETERS

by

Jimmy L. Dodd

ABSTRACT

A fan-beam and single-beam radiometer system has been designed and constructed for NASA by the IIT Research Institute, Chicago, Illinois. This system has been previously used to study cloud movement and smoke movement.

Smoke plume data were taken using the stacks of the Mills Road Steam Plant on Redstone Arsenal, Huntsville, Alabama. The fan-beam unit was placed approximately 235 meters east of the Mills Road Steam Plant and the single-beam unit was placed approximately 80 meters north of the fan-beam unit. Results of the smoke plume measurements indicate that the smoke plume is a periodic process near the mouth of the smokestack.

The usefulness of the system is limited because of inaccurate and cumbersome positioning methods and base line constraints due to cable length. It is recommended that the radiometers be mounted on pedestals which have both azimuth and elevation positions determined by digitally controlled stepper drive motors. It is also recommended that a time multiplex system be used to transmit data from the radiometers to the electronics van.

SHAPED BEAM KU-BAND ANTENNA DESIGN

By James E. Dudgeon

ABSTRACT

Antenna systems for a Ku-band synchronous orbit communications satellite were considered. Desired was a wideband antenna system, which is capable of simultaneously, or individually, illuminating the four Continental U.S. (CONUS) time zones and possibly Alaska and Hawaii. Possible applications would be for national or regional educational TV, medical information centers and consultation networks, disaster warning, law enforcement networks, and remote area broadcast coverage.

A multiple beam offset feed cluster used in conjunction with an offset parabolic reflector was chosen for the antenna realization. For radiating elements in the feed array, polyrod or dielectric rod radiators fed by waveguide are investigated. Polyrod antennas shrink the cross-section of the waveguide required, are fairly directive, and can be tapered to reduce sidelobes. As a consequence, it is thought that mutual coupling effects between adjacent elements will be minimal and the resultant physically small elements will allow greater packing densities for the drive elements in the feed array than would otherwise be possible.

Aperture distributions and corresponding ground patterns (footprints) produced by polyrod elements in an offset feed structure are found. Also the propagation from a ground area back onto the feed aperture is formulated and related to the use of physically realizable feed elements. The problems of high density feed elements, maintaining low sidelobe levels to meet international standards, aperture blocking, and feed placement (F/D) tradeoffs are considered.

A PRELIMINARY STUDY OF A BUOY SYSTEM FOR ACQUISITION, TRANSMISSION, AND MANAGEMENT OF HYDROLOGICAL DATA OBTAINED FROM IN-SITU MEASUREMENTS

By

J. Mark Elliott

ABSTRACT

The requirements for a system of remotely located, data collection buoys are considered first for a prototype system to be used in conjunction with the Earth Resources Technology Satellite (ERTS-A), and then for a more advanced system. The necessary sensor characteristics for compatibility with the ERTS-A Data Collection Platforms are considered as well as possible sites for location of the prototype buoys. The advanced system is considered from the standpoint of continuous data collection both through satellite data relay and ground telemetry systems.

Management of the data from a buoy system is analyzed, especially with regard to the advanced system.

A LIMITED SURVEY OF GENERAL PURPOSE FINITE ELEMENT COMPUTER PROGRAMS

By

Jerome Charles Glaser

ABSTRACT

General purpose programs based on the finite element method are considered a basic tool in structural analysis. To be effective, these programs should have "state-of-the-art" capabilities. Thus, there is a need for periodic review of these programs to assess their effectiveness.

Past surveys of finite element computer programs exist which point out general characteristics but lack details on available analysis methods and types of modeling elements. Also, more recent program development has been largely concerned with nonlinear structural analysis.

This report contains a comparison of ten representative programs. A listing of additional programs encountered during the course of this effort is also included. Tables are presented to show the structural analysis, material, load, and modeling element capability for the ten selected programs. These tabular comparisons provide a reasonable picture of the analyses and elements one would expect to find in a current general purpose program.

INVESTIGATION OF SOME CHARACTERISTICS RELATED TO PCM THERMAL CAPACITORS

BY

EDWIN I. GRIGGS

ABSTRACT

This report presents some results of a continuing experimental and analytical investigation of the thermal behavior of a PCM thermal capacitor. Fundamentally, a thermal capacitor is a device which provides attractive energy storage capability through utilization of a phase change material (PCM). Functionally, these units may play the role of a thermal flywheel by depressing temperature fluctuations caused by a changing thermal environment or they may serve as a heat sink to delay transient temperature rises. Since their operation is passive, these devices are particularly suitable for applications in the space program, a fact exemplified by the variety of current as well as proposed future applications.

In order for capacitor designs to fully and successfully exploit the advantages of the phase change concept, the PCM should have a high value of thermal diffusivity; this, however, creates a problem since the prime PCM candidates (n-paraffins), based on other considerations, have very low values of this property. To overcome this problem and achieve improved heat transfer in practice, metallic fins or some other form of metallic filler is embedded within the PCM. Such an arrangement, however, complicates an exact thermal analysis because of the introduced inhomogeneities and multidimensional effects.

The objectives of this work were (1) to continue to investigate and evaluate numerical techniques for predicting thermal performance within a thermal capacitor and (2) to monitor a series of tests on an invertable thermal capacitor. The numerical study is a continuation of an effort initiated during participation in the 1971 NASA/ASEE Faculty Fellowship Program. During this former period, in addition to developing some background in the area, a numerical study utilizing an explicit formulation was directed to the prediction of the heat transfer within a single rectangular cell formed by metallic fins enclosing the PCM. Hopefully, in order to provide greater flexibility, shorten computer time, and provide potential for a parametric study, attention during this summer has been devoted to an implicit numerical scheme. A discussion of this effort is presented. The experimental work involved outlining and monitoring approximately fourteen tests of an invertable capacitor. Surface and PCM temperatures were measured at several locations and photographs were made of the PCM during melting and solidification. Some typical experimental results are presented and discussed.

THERMAL CONTROL OF THE SCIENTIFIC INSTRUMENT PACKAGE IN THE LARGE SPACE TELESCOPE

by

Keith H. Hawks

ABSTRACT

A study of the thermal control concepts suitable for the thermal control of the Scientific Instrument Package (SIP) in the Large Space Telescope (LST) was conducted. The data generated last summer by the author's parametric study of heat rejection concepts suitable for spacecrafts were used as a study guide.

The general thermal control system philosophy was to utilize passive control where feasible and to utilize active methods only where required for more accurate thermal control of the SIP components with narrow temperature tolerances.

A thermal model of the SIP and a concept for cooling the SIP cameras are presented. The model and cooling concept have established a rationale for determining a Phase A baseline for the thermal control of the SIP. A discussion of the involvement of the author's work in selecting the baseline design is given.

NONEQUILIBRIUM AND EQUILIBRIUM RADIATION TO THE SPACE TUG FROM THE SHOCK LAYER

BY

William L. Hendricks

ABSTRACT

Preliminary estimates of the thermal radiation heat transfer to an aerobraking Space Tug are presented. The Tug is descending from a geosynchronous orbit to a low Earth orbit on one or more passes through the atmosphere. For the flight regime of the Tug, between a velocity of 22,000 ft./sec. and 34,000 ft./sec. with an altitude between 220,000 ft. and 340,000 ft., the nonequilibrium radiation can be more than 1,000 times larger than the value of the equilibrium radiation. Therefore, an analysis of the radiative heating for these altitudes must include the nonequilibrium radiation from the shock layer.

An uncoupled radiation-gas dynamics solution for an optically thin gas is obtained using a small perturbation analysis with the radiationless solution as a reference state. The nonequilibrium radiation model consists of two gaseous regions in the shock layer. The region immediately behind the shock is radiating at a temperature corresponding to translational and rotational equilibrium (γ = 1.4) while the gas behind this relaxation zone is radiating at the equilibrium temperature. This relaxation distance is assumed to be a constant fraction of the actual measured relaxation distance in order for the heat flux to closely approximate that from the actual exponentially decaying temperature profile. The analytical expression obtained from this model gives a quick estimate of the stagnation point radiation heat transfer including nonequilibrium radiation. An expression for the radiation heat flux distribution around a spherical body is also presented.

Preliminary estimates of the radiative and convective heating for a one pass aerobraking trajectory are given for several body radii. The radiative heating rates are essentially proportional to body radius while the convective heating is inversely proportional to the square root of the body radius. For a typical body radius of 7 ft., the maximum stagnation heating rate from radiation is nearly one half that from convection.

THE PROSPECTS OF UTILIZING REMOTELY SENSED DATA IN THE PREPARATION OF ENVIRONMENTAL-SOCIOLOGICAL MODELS

By

Robert B. Honea

ABSTRACT

Many of the problems presently confronting society are of such inordinate complexity that it will take most, if not all, of our technological abilities to assemble data, to analyze and effect solutions. To force society to accept the proposition that nature is process, that it is interacting, that it responds to laws, and that it represents values and opportunities for human use with limitations and even prohibitions, is one of our major obstacles. Beyond this realization, however, less evangelical concepts must be considered. This research deals with such concepts.

With the establishment in 1969 of a new national policy to protect the environment, the various agencies of federal, state and local governments and other concerned public and private organizations charged with the responsibility of preparing environmental impact statements, became acutely aware that present data acquisition systems either lacked the necessary detail or were so costly and tedious as to negate their use in impact studies.

The use of remote sensing to acquire needed data concerning soils, water conditions, micro-climatic conditions, flora, land use, recreational potential and cultural conditions appears to hold great promise in solving data needs. This report demonstrates the procedures and means whereby such data can be acquired and processed into an information format. Illustrations have been developed which show how these data and information might be incorporated into models which will permit one to predict the future environmental and cultural impact of proposed development projects.

STUDY OF ICE PARTICLE FORMATION AND LIFETIME IN SPACE ENVIRONMENT

BY

Duen-Ren Jeng

ABSTRACT

The ice particles are formed when liquid and/or humid gases vent to the space. These submicroscopic ice particles are potential contamination sources of the environments during Skylab operations.

The analysis is made for predicting the critical size of ice particle formed and its nucleation rate based on the theory of homogeneous and heterogeneous nucleation by sublimation.

The equations which are pertinent for studying the growth and evaporation of the ice particles are formulated. The mechanisms affecting the lifetime of ice particle are discussed.

The gasdynamic techniques for experimental study of ice particle formation are proposed.

SATELLITE AERODYNAMICS AND ATMOSPHERIC DENSITY DETERMINATION FROM SATELLITE DYNAMIC RESPONSE

by

Gerald R. Karr

ABSTRACT

A method for determining satellite aerodynamic properties and upper atmospheric density from observed satellite dynamic response has been successfully developed and tested.

The aerodynamic drag and lift properties of a satellite are first expressed as a function of two parameters associated with the gas-surface interaction at the satellite surface. The dynamic response of the satellite as it passes through the atmosphere is then expressed as a function of the two gas-surface interaction parameters, the atmospheric density, the satellite velocity, and the satellite orientation to the high speed flow. By proper correlation of the observed dynamic response with the changing angle of attack of the satellite, it is found that the two unknown gas-surface interaction parameters can be determined. Once the gas-surface interaction parameters are known, the aerodynamic properties of the satellite at all angles of attack are also determined. The atmospheric density may then be accurately calculated once the true aerodynamic properties are known.

Employing accelerometer data from the OVI-15 satellite, analysis was successfully made of the aerodynamic properties of that satellite and a determination was made of the absolute value of atmospheric density near the orbit perigee. These results constitute the first successful application of the proposed method of analysis. These results also serve to illustrate the potential of the technique in the analysis and prediction of satellite orbit decay in the atmosphere and the accurate determination of upper atmospheric density from satellite dynamic response.

LARGE SILVER HALIDE SINGLE CRYSTALS AS TRACK DETECTORS FOR HEAVY CHARGED PARTICLES

by

John H. Kusmiss

ABSTRACT

Large silver halide single crystals can be used to record the passage of heavy charged particles. The trajectory of the particle is made visible under a microscope by the accumulation of metallic silver at regions of the lattice damaged by the particle. This "decoration" of the particle track is accomplished by exposure of the crystal to light. The decoration of normally present lattice imperfections such as dislocations can be suppressed by the addition to the crystal of less than ten parts per million of a suitable polyvalent metal impurity. In fact, careful control of the concentrations of metallic impurities is absolutely necessary because they play important roles in the details of the track decoration process.

Large single crystals of the silver halides present certain immediate advantages over photographic emulsions as track detectors for heavy charged particles. The decoration of tracks in large single crystals requires only a few hours, and the distortion of tracks associated with the development of nuclear emulsions is not encountered. Because the mass density of a large silver halide single crystal is roughly twice that of a photographic emulsion, a 0.5 cm thick crystal corresponds to a 1.0 cm thick emulsion stack. Moreover, the possibility apparently exists of being able to decorate the path of a particle at the time it passes through an impurity-doped AgCl crystal, but not at later times, thus providing a means of using these crystals as "triggered" detectors. Another attractive possibility for these detectors is being able to vary the threshhold for the rate of ionization necessary to produce a track; it has been claimed that this can be done by setting the level of impurity doping. The potential utility of silver halide single crystals as heavy ion detectors and dosimeters in space applications is obvious.

This report presents a brief review of the published work pertaining to silver halide single crystals as charged particle detectors and some comments as to the course which future work should take. An account of some preliminary attempts to grow thin single crystals of AgCl is given also, and suggestions for a more refined technique are offered.

DETERMINATION OF OPTICAL CONSTANTS OF In Bi FROM REFLECTANCE MEASUREMENTS

By

Frank E. Martin

ABSTRACT

Electromagnetic theory makes possible the determination of optical constants of a substance as functions of wavelength from reflectance data measured for different angles of incidence. These constants are the real index of refraction n and the absorption coefficient k, and they are related by

$$N = n + ik$$

where N is the complex index of refraction.

Reflectance measurements were made on samples of the intermetallic compound In Bi. A fall in reflectance was noted from values obtained for a freshly cleaved sample to values obtained after periods of exposure of the surface to air. The decrease in reflectance with increased exposure time is attributed to formation of a surface layer insoluble in Freon or ethyl alcohol; it is therefore, assumed to be a tarnish layer. Computer processing was employed to calculate optical constants form reflectance data.

DATA TRANSMISSION SIGNAL DESIGN AND ANALYSIS

by

Jerry D. Moore

ABSTRACT

The error performances of several digital signaling methods are determined as a function of a specified signal-to-noise ratio. This consolidates some of the results presented in the literature and provides a consistent method for a comparative performance analysis. Results are then obtained for Gaussian noise and impulse noise. Performance of a receiver for differentially encoded Biphase signaling is obtained by extending the results of differential phase shift keying. The analysis presented obtains a closed-form answer through the use of some simplifying assumptions. The results give an insight into the analysis problem, however, the actual error performance may show a degradation because of the assumptions made in the analysis. Bipolar signaling decision-threshold selection is investigated. The optimum threshold depends on the signal-to-noise ratio and requires the use of an adaptive receiver. The specifications for a minimax receiver are provided for the case of a fixed threshold level, constant noise power, and variable signal power. These conditions are possible for a data bus where the transmission media changes. An orthogonal signal set is proposed as a new data bus signal candidate. The frequency spectrum for the signal has a discrete component at the bit rate and a continuous portion that resembles the Biphase spectrum.

Abstract

Optical Production and Detection of Ultrasonic Waves
in Metals for Nondestructive Testing

by

Richard A. Morrison

Ultrasonic waves have been produced by striking the surface of a metal with the focused one-joule pulse of a Q-switched ruby laser. Rayleigh (surface) waves, and longitudinal waves have been detected with conventional transducers.

Optical methods of detection have been tested and developed. Rayleigh waves were produced with an oscillator and transducer. They have been optically detected on curved polished surfaces, and on unpolished surfaces. The technique uses a knife edge to detect small angle changes of the surface as the wave pulse passes the illuminated spot. Optical flaw detection using pulse echo and attenuation is demonstrated.

Optical detection methods are used to study the Q-switched ruby pulse. It is concluded that focusing of the ruby pulse with an inexpensive cylindrical lens leaves shallower scars on the surface, and produces better directed waves. It is strongly suggested that the Q-switched pulse is slow and limits the frequency response of the system.

AN ANALYSIS OF TEXTURE ON LUNAR GROUND PHOTOS

By

Judy Olson

ABSTRACT

Texture is one of the major aspects of a single lunar ground photo giving information about the distance to features. If texture is measurable and its relation to distance known, it could perhaps be incorporated into simulations of views from particular ground locations.

An experiment was performed in an attempt to evaluate autocorrelation as an indicator of texture using five small patches representing varying distances on each of four lunar photos. Each patch was scanned at 50 micron increments on a 64-level gray scale. Several problems were involved in using the ordinary autocorrelation value but a rougher "autocorrelation" measure, the percentage of neighboring pairs (at a given lag distance) which fell within one graylevel of one another, yielded very encouraging results. As the distance to the feature decreased, initial slope of the graph of percentage against lag increased and the general level of the graph decreased. When a crestline was present, the graph tended to continue to decrease at higher lags as well, rather than leveling off after the initial steep slope.

Further study is needed to relate such characteristics to more precisely known distances, to look into the effects of variables such as lighting conditions, and to find a feasible method of incorporating the feature into simulated views.

SIMULATION, MANUAL AND COMPUTERIZED (SMAC)

By

Murl Wayne Parker

ABSTRACT

Monte Carlo simulation of discrete stochastic real world systems has become a major problem solving technique in recent years with the development of high speed, high capacity computers. Projections indicate that this trend will continue in the foreseeable future.

As in the use of any new tool, acceptance of simulation results is limited by the understanding of the technique. To overcome this limitation, Simulation, Manual and Computerized (SMAC) has been developed. The guiding concept was to develop a simulation modeling method which can be quickly taught and learned, yet can be used to solve significant real world problems.

SMAC consists of two manual simulation methods and one computer program. One of the manual methods is designed to impart an understanding of simulation; the other is designed to be a practical simulation method.

The computer program will simulate queueing situations with up to five parallel servers or up to three series servers. The program is built around GASP IIA routines and retains the 8K capability of GASP.

COHERENT OPTICAL PROCESSING OF PHASED ARRAY RADAR DATA

By Jerry W. Rogers

ABSTRACT

This study deals with interfacing a coherent optical processor, which utilizes an electron-beam addressed KD*P crystal modulator, with a linear phased array. For completeness, an abbreviated development of typical radar signals from a linear array is included.

A plan for formating the spatial modulator with linear array signals is presented. The theoretical expectations which include target angle and doppler are derived.

A simulated set of M signals which are typical of a linear array of M elements was devised. This set of signals was used to modulate the wave front of collimated laser light via the KD*P crystal according to the format presented. The results are compared with those which theory predicts.

AVOIDANCE OF TRAILING VORTEX HAZARD BY AIRPORT WARNING SYSTEM

By

Robert S. Rudland

ABSTRACT

Over the years, increased air traffic has warranted a number of innovations, such as radar control for the airport operators in handling heavier traffic, and jumbo jets for the air carriers in handling more passengers. This combination of larger aircraft and heavier traffic pose a unique problem in air traffic operations, that of "Trailing Vortex Hazard." The air traffic controller must attempt to avoid placing medium and small aircraft too closely behind a heavy aircraft (> 300,000 lbs) in the landing or takeoff pattern. This is at cross purposes with his efforts to handle ever increasing numbers of aircraft operations.

In an effort to improve air traffic operations in the vicinity of airports (especially landing and takeoff corridors), an Airport Trailing Vortex Warning System (ATVWS) has been developed at NASA to predict "Trailing Vortex Hazard" conditions. The ATVWS consists of a computer simulation of the vortex and its effect upon an encountering aircraft. This has been coupled with a vortex detector model and programmed for typical airport traffic such as that found at the Atlanta Municipal Airport.

This study of the Atlanta Airport provides a first attempt in determining the effective design of a detector-predictor ATVWS which would greatly improve the efficiency in handling all air traffic. An additional benefit would also be seen in increased airport safety.

ORBIT PERTURBATIONS DUE TO SOLAR RADIATION PRESSURE

By

Gary A. Sawyer

ABSTRACT

This report presents the results of an investigation into the effects of solar radiation pressure upon the orbit of an artificial satellite. This disturbing force will be important for satellites with a large area to mass ratio and also for those whose orbits are high enough that atmospheric drag is not the more dominate force.

The procedure used for the analysis is to represent the radiation force as the gradient of a scalar function to be compatible with existing procedures for studying perturbations due to earth's oblateness. From this analysis, solar radiation pressure appears not to be responsible for any secular or long-periodic variations in the semi-major axis of the orbit nor does it provide any secular changes in the eccentricity of the orbit or the angle of inclination of the osculating plane. Solar radiation pressure does produce secular effects in the other orbital elements, but these are in the opposite sense of secularities caused by the gravitational attraction of the sun and therefore tend to slightly reduce the total secularity.

A Multi-Ring Ionospheric Plasma Probe

By

John W. Sheldon

ABSTRACT

An ionospheric plasma probe has been constructed which consists of a long cylinder with the end facing the flow closed by an end plate made up of multiple annular rings and a center disk. A theoretical argument is given which yields the plasma potential and electron temperature in terms of known plasma parameters and the currents to the various rings of the end plate.

This probe was successfully operated in an ionospheric flow simulation facility and the resulting plasma potential (1.21 $\pm$ .05 volts) is in excellent agreement with the traditional Langmuir analysis (1.22 volts).

I. CABLE CONNECTED SPINNING SPACECRAFT

II. THE CANONICAL EQUATIONS

III. URBAN MASS TRANSPORTATION

By

Amnon Sitchin

ABSTRACT

Last year's work on the dynamics of cable-connected spinning spacecraft was completed by formulating the equations of motion by both the Canonical equations and Lagrange's equations and programming them for numerical solution on a digital computer. These energy-based formulations will permit future addition of the effect of cable mass. Comparative runs indicate that the Canonical formulation requires less computer time.

Available literature on urban mass transportation was surveyed. Areas of the PRT (Private Rapid Transit) concept of urban transportation to which the expertise of the Dynamics and Control Division could be applied in support of the NASA/DOT program of study and research in automated ground transportation systems are identified.

AUTOMATIC CONTROL OF PERSONAL RAPID TRANSIT VEHICLES

by

Paul D. Smith

ABSTRACT

One promising solution to the urban transportation problem is the development of personal rapid transit systems.

The requirements for automatic longitudinal control of a string of closely packed personal vehicles are outlined. Optimal control theory is used to design feedback controllers for strings of vehicles and the previous work in this area is reviewed. An important modification of the usual optimum control scheme is the inclusion of "jerk" in the cost functional. While the inclusion of the jerk term has been considered by other investigators, the effect of its inclusion has not been sufficiently studied. Adding the jerk term will increase passenger comfort.

A proposed outline of investigation is included to solve the optimal control problem and the sensitivity problem associated with developing engineering specifications on the vehicle controls.

THE VALUATION OF SCIENTIFIC AND TECHNICAL EXPERIMENTS

By

Fred E. Williams

ABSTRACT

This study broadly concerns rational selection of scientific and technical experiments for space missions. Particular emphasis is placed on the assessment of "value" or "worth" of an experiment.

It is argued that the assessment of such a "value" necessarily entails judgmental (subjective) inputs; hence "assessment of value" is taken to mean the construction of a numerical index which (1) represents the preferences of an appropriate decision maker (possibly a group) and (2) possesses certain desirable properties. The requirements are satisfied by a Bernoulli Utility Indicator (BUI) representing the decision maker's preferences, hence in operational terms "assessment of value" means specification of such a BUI.

A specification procedure is outlined and discussed for the case of one decision maker. Experiments are viewed as multi-attributed entities and a relevant set of attributes is proposed. Alternative methods of describing levels of the attributes are proposed and discussed. The reasonableness of certain simplifying assumptions such as preferential and utility independence is explored, and it is tentatively concluded that preferential independence almost certainly applies and utility independence appears to be quite appropriate.

The general specification procedure is then extended to include the possibility of more than one decision maker. The feasibility and potential difficulties of this extension are explored, and the suggested procedure is judged to be quite practicable.

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16. ABSTRACT

For the ninth consecutive year, the NASA-ASEE Summer Faculty Fellowship Program was continued in 1972. Six NASA Centers cooperating with nine universities conducted research programs for young engineering and science teaching and research faculty members. In addition to the research programs, there were four systems engineering design programs conducted at four of these Centers.

This year, the research type program at Marshall Space Flight Center was continued for the eighth consecutive year and was directed by Auburn University with assistance from the University of Alabama. This final report presents the results of the program at MSFC.

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